NUTRIENT UPTAKE

Nutrient Uptake of Hybrid and Common Bermudagrass Fertilized with Broiler Litter

G. E. Brink,* K. R. Sistani, and D. E. Rowe

ABSTRACT

Among forage crops utilized in the southeastern USA, bermudagrass [*Cynodon dactylon* (L.) Pers.] has the greatest potential to recover nutrients from soil routinely fertilized with broiler litter due to its yield potential and wide adaptation. Our objective was to determine differences in N and P uptake among diverse bermudagrass cultivars fertilized with broiler litter. 'Alicia', 'Brazos', 'Coastal', 'Russell', 'Tifton 44', and 'Tifton 85' hybrid bermudagrass and common bermudagrass were grown on a Savannah fine sandy loam (fine-loamy, siliceous, semiactive, thermic Typic Fragiudult) and fertilized with 11.8 Mg litter dry matter (DM) ha^{-1} yr^{-1} (15.75 Mg as-is basis) to provide 540 kg total N ha^{-1} yr^{-1} and 330 kg total P ha^{-1} yr^{-1} (mean of 4 yr). Alicia, Coastal, and Russell had similar annual yield in 3 of 4 yr, but yield differences among other hybrids were not consistent. Although annual N and P uptake of common bermudagrass was equivalent to Alicia, Coastal, and Tifton 44 during 2 yr due primarily to greater herbage N and P concentration, reduced uptake in years of below-normal precipitation indicates it is not an acceptable alternative to a hybrid. No differences in N uptake existed among a majority of hybrids when precipitation was near normal, and Alicia, Coastal, and Russell had equivalent N uptake all 4 yr. Nitrogen and P uptake of Tifton 85 increased each year and, by the final year of the study, exceeded that of all cultivars. Among all the hybrids, only Russell exhibited consistent superior P uptake relative to Coastal.

Broiler chicken (*Gallus gallus*) production in the USA is concentrated in Georgia, Arkansas, Alabama, Mississippi, North Carolina, Texas, South Carolina, and Tennessee (70% of total U.S. production; National Agricultural Statistics Service, 2001). Due to the susceptibility of soils to erosion in the region, the positive association between beef cattle production and broiler house siting (Alabama Agricultural Statistics Service, 2003), and the need to dispose of manure intermittently in the absence of storage facilities, a large proportion of the 10 million Mg of broiler litter (a mixture of manure, wasted feed, feathers, and wood shavings or other crop residue) produced annually is applied to hay fields and pastures (Bagley et al., 1996). The predominant forage in many areas of the region is bermudagrass (Burton and Hanna, 1995), a tropical perennial grass that responds readily to applied fertilizer (Overman et al., 1993) and intensive hay harvest management (Overman et al., 1990). Application of broiler litter is often made at rates that meet or exceed the annual N requirement of bermudagrass to minimize purchase of inorganic N fertilizer. Because the N/P ratio of litter is considerably lower than the ratio of N and P absorbed from the soil by the grass (2:1 vs. 10:1; Edwards, 1996), soil P levels on many broiler farms are substantially greater than those required for maximum forage yield (Sims et al., 2000).

Intensive harvest management of a forage crop represents an important component of nutrient management despite the fact that soil P levels may be reduced slowly, remain unchanged, or even increase due to continued manure application (Kingery et al., 1993). Nutrient uptake by bermudagrass may be influenced by the rate and timing of manure application (Brink et al., 2002; Burns et al., 1990), the choice of a temperate forage species with which it is overseeded (Rowe and Fairbrother, 2003), or supplemental application of inorganic fertilizer in addition to manure (Evers, 2002). Response of bermudagrass to manure application may differ from its response to inorganic fertilizer, particularly when soil type differs. Brink et al. (2003) found that bermudagrass growing on a Brooksville silty clay loam (fine, smectitic, thermic Aquic Hapludert) and fertilized with swine (*Sus scrofa*) effluent at an N rate roughly equivalent to that fertilized with inorganic fertilizer on a Fuquay loamy sand (loamy, kaolinitic, thermic arenic Plinthic Kandiudults; Day and Parker, 1985) had greater herbage concentration and annual uptake of N and P.

Several hybrid bermudagrass cultivars have become available to producers in the southeastern USA since the release of Coastal in 1943 (Burton, 1954), considered the standard with which new cultivars are compared. Alicia, Russell (Ball et al., 1996), and Tifton 44 (Burton and Monson, 1978) are similar to Coastal in morphology, with an erect growth habit, moderately coarse stems, and fine leaves. Brazos (Alabama Coop. Ext. Service, 1996) and Tifton 85 (Burton et al., 1993) are generally taller with wider leaves and thicker stems than Coastal. Unimproved common bermudagrass is present in many pastures and hay fields across the southeastern USA, and while growth is highly variable, it is usually shorter with finer leaves and a denser growth habit than the hybrids (Burton and Hanna, 1995). Yield and nutrient uptake of these cultivars were evaluated previously (Brink et al., 2003), but differences in the manure source for the previous study (swine effluent) and this study (broiler litter) warranted separate consideration of the results. Unlike broiler litter, swine effluent serves not only as a source of nutrients but also water, which could reduce

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Abbreviations: DM, dry matter.

Table 1. Mineral characteristics of the soil (Mehlich-3) at the beginning of the experiment at Mize, MS.

Depth	pH	N	Ca	K	Mg	P	Cu	Fe	Mn	Zn
cm		—— g kg^{-1} ——		—— mg kg^{-1} ——						
0–5	6.2	1.68	1.17	300	150	800	39	353	232	44
5–10	6.4	1.01	0.90	220	100	577	25	316	234	24

the advantage hybrids have over common bermudagrass for drought tolerance (Burton and Hanna, 1995). When fertilized with swine effluent, Brink et al. (2003) found that N and P uptake of common bermudagrass were equivalent to that of several hybrids at two locations. In addition, the availability of N and P in litter compared with effluent would likely differ due to the influence of mineralization.

Routine application of broiler litter to bermudagrass pastures and hay fields and the growth of this grass on soils typically high in available nutrients, particularly P, requires additional information about potential cultivar-dependent responses. The objective of this experiment was to determine differences in N and P uptake among diverse bermudagrass cultivars fertilized with broiler litter.

MATERIALS AND METHODS

The study was conducted over 4 yr (1998–2001) on a farm near Mize, MS (31.8°N, 89.6°W) on a Savannah fine sandy loam. A detailed history of broiler litter application to the field before the experiment was not available, but litter was typically applied at rates that exceeded the annual N requirements (6.8–12.0 Mg DM ha^{-1} yr^{-1}) of the ryegrass (*Lolium multiflorum* Lam.) and crabgrass [*Digitaria sanguinalis* (L.) Scop.] utilized for pasture. Before plots were established in 1997, soil samples were collected in the plot area at 0- to 5- and 5- to 10-cm depth from 20 cores and composited by depth. Soil chemical characteristics were determined using Mehlich-3 extractant (Mehlich, 1984; Table 1). Total soil N concentration was determined by the Dumas method (Bremner, 1996). The plot area was also sprayed with glyphosate [*N*-(phosphonomethyl) glycine] at a rate of 2.24 kg a.i. ha^{-1}. Monthly precipitation for the duration of the experiment is presented in Fig. 1.

Alicia, Brazos, Coastal, Russell, Tifton 44, and Tifton 85 hybrid bermudagrass, and common bermudagrass were established from sprigs in June 1997 in 2 by 6 m plots separated by a 1-m alley in a randomized complete block design with four replicates. In July 1997 ammonium nitrate fertilizer was applied at 56 kg N ha^{-1} to stimulate growth. Plots were covered with vegetation by September 1997 and were considered established. Contamination of plots by bermudagrass rhizomes or stolons from adjacent plots was prevented by spraying alleys with glyphosate after each harvest. Beginning in late May of each of the next 4 yr, plots were harvested every 6 wk, four times per year. Before harvest, herbage growing outside the plot borders was clipped to a 5-cm stubble and discarded. Forage yields were determined by cutting a 1 by 6 m swath at a 5-cm stubble height through the center of each plot with a sickle-bar mower. A 600- to 800-g subsample was taken from each yield sample, dried at 65°C for 48 h, weighed to determine forage DM, and then ground to pass a 2-mm screen. A 50-g subsample of the ground forage was stored in plastic bottles.

Forage N concentration of each harvest was determined by the Dumas method (Bremner, 1996). Forage P concentration of each harvest was determined by ashing a 0.8-g subsample in a ceramic crucible at 500°C for 4 h followed by the dissolution of the ash in 1.0 mL of 6 *M* HCl for 1 h and then in an additional 40 mL of a double acid solution of 0.0125 *M* H_2SO_4 and 0.05 *M* HCl for another hour, and filtering through Whatman no. 1 paper (Southern Cooperative Series, 1983). The P concentration of the filtrate was measured by emission spectroscopy on an inductively coupled argon plasma spectrophotometer.

Broiler litter was applied in early May at 6.75 Mg DM ha^{-1} and in mid-July at 5.05 Mg DM ha^{-1} in 1998, 1999, 2000, and 2001. Litter was obtained from a nearby broiler house to avoid changes in N concentration caused by composting that occurs during storage (Eghball and Power, 1999). Litter DM was influenced little by application date (mean of 750 g DM kg^{-1}). An 800- to 1000-g subsample of the litter was obtained at each application and stored in a sealed plastic bag at 2°C. Before

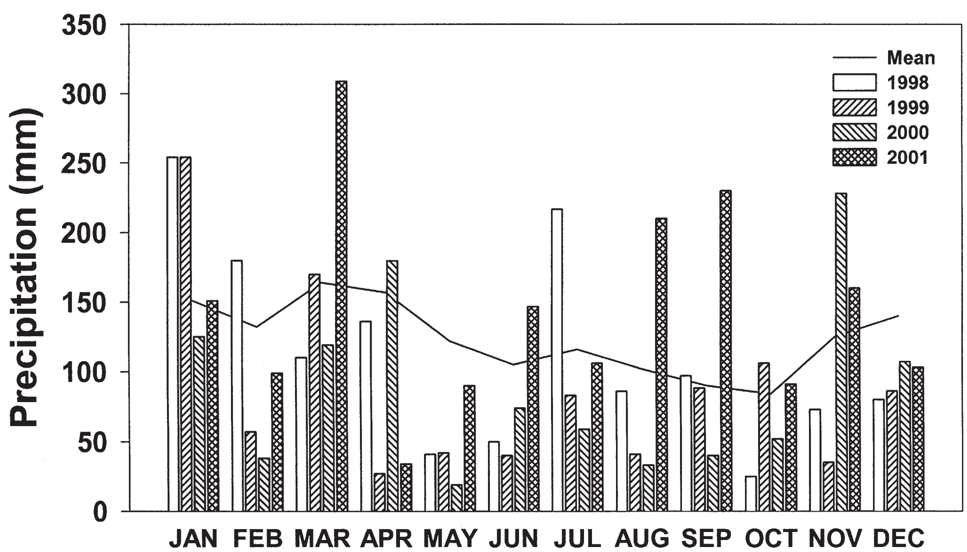

Fig. 1. Monthly precipitation for the study period and 30-yr mean at Mize, MS.

Table 2. Mineral concentration of the broiler litter and quantity applied each year at Mize, MS.

Date	pH	N	Ca	K	Mg	P	Cu	Fe	Mn	Zn
		g kg^{-1}					mg kg^{-1}			
1998 May	7.4	32.0	28.7	30.7	7.2	19.3	596	925	786	709
July	7.3	33.1	27.4	34.2	6.7	20.4	652	769	688	667
1999 May	7.5	40.3	31.0	31.3	7.7	24.2	838	838	837	591
July	7.6	35.4	28.2	30.5	7.3	21.6	716	756	762	638
2000 May	7.7	34.9	30.1	29.6	6.1	22.5	687	837	631	416
July	7.8	32.7	29.8	28.7	6.5	19.8	632	795	703	456
2001 May	7.4	32.5	30.9	29.1	6.4	20.8	541	1040	657	455
July	7.6	30.7	26.2	28.3	5.8	18.1	457	702	559	380
		kg ha^{-1}								
1998 May		288	258	276	65	174	5.36	8.32	7.07	6.38
July		223	185	231	45	138	4.40	5.19	4.64	4.50
1999 May		363	279	282	69	218	7.54	7.54	7.53	5.32
July		239	190	206	49	146	4.83	5.10	5.14	4.31
2000 May		314	271	266	55	202	6.18	7.53	5.68	3.74
July		221	201	194	44	134	4.27	5.37	4.74	3.08
2001 May		292	278	262	58	187	4.87	9.36	5.91	4.10
July		207	177	191	39	122	3.08	4.74	3.77	2.56

mineral analysis, litter was thawed for 4 h and ground to pass a 2-mm screen. Litter pH was measured in 1:5 litter/water mixture. Litter N and P concentration, as well as Ca, K, Mg, Cu, Fe, Mn, and Zn concentration, were measured by the same methods used to analyze forage, and used to calculate the quantity applied (Table 2). The litter applied each year (11.8 Mg litter DM ha^{-1}) contained more total N (500–600 kg ha^{-1} yr^{-1}) than would typically be applied as inorganic fertilizer, but the total quantity of N available for bermudagrass growth would be reduced due to volatilization (Brinson et al., 1994) and incomplete mineralization (Gordillo and Cabrera, 1997).

Annual DM yield was calculated as the sum of the DM yield of the four harvests within years. Annual N and P uptake were calculated as the product of the DM yield and N or P concentration at each harvest and summed over all harvests within years. Herbage N/P ratio was calculated as N concentration/P concentration of each harvest. Annual DM yield, annual N and P uptake, herbage N and P concentration of each harvest, and herbage N/P ratio of each harvest were subject to analysis of variance using SAS (SAS Inst., 1999). While DM, N, and P yield are quantities that can be summed over the growing season, herbage nutrient concentrations are not, and thus herbage N concentration, P concentration, and N/P ratio were analyzed for individual harvests. Significance of year, cultivar, and their interaction are presented in Table 3. Means for each cultivar were compared using Fisher's protected LSD ($P \leq 0.05$). Pearson correlation coefficients between annual DM yield and annual nutrient uptake were calculated on an entry mean basis and are reported at $P \leq 0.001$. Efficiency of N and P uptake by each cultivar were calculated as annual N or P uptake/annual N or P applied in the litter. Litter N/P ratio was calculated as N concentration/P concentration at each application.

RESULTS AND DISCUSSION

Significant ($P < 0.001$) year × cultivar interactions were found for annual DM yield, and annual N and P uptake (Table 3). There were no significant year × cultivar interactions for herbage N and P concentration, and N/P ratio of each harvest.

Dry Matter Yield

Precipitation from May to September of 1999 (294 mm) and 2000 (225 mm) was considerably below normal (535 mm) compared with 1998 (491 mm) and 2001 (783 mm; Fig. 1) and probably contributed to lower annual DM yield of all cultivars except Tifton 85 (Fig. 2). The relative effect of dry weather was most detrimental to common bermudagrass; annual DM yield of common was 55% of that of Coastal hybrid bermudagrass in 1999 and 2000 compared with 99% in 1998 and 76% in 2001. Annual DM yield of common bermudagrass was less than that of the hybrids in 3 of 4 yr (Fig. 2).

Russell, Alicia, and Coastal, hybrids with similar growth morphology, had similar DM yield in 3 of 4 yr (1999, 2000, 2001; Fig. 2), but yield differences among other cultivars were not consistent from year to year. For example, Tifton 44 yielded more DM than all cultivars except Russell and Alicia in 1998, but less DM than all cultivars except Brazos in 2000. In 2001, there was no difference in annual DM yield among five of the six hybrids. Annual yield of Tifton 85 increased in successive years after establishment until the final year of the experiment, when it produced more DM (21.3 Mg ha^{-1}) than all other cultivars. Burton et al. (1992) stated that

Table 3. Significance of year, cultivar, and their interaction on annual DM yield, annual N and P uptake, and herbage N concentration, P concentration, and N/P ratio (harvest number in parenthesis) of seven bermudagrass cultivars grown at Mize, MS, for each of 4 yr.

	Source of variation, df		
Parameter	Year (3)	Cultivar (6)	Year × cultivar (18)
DM yield	***	***	***
N uptake	***	***	***
P uptake	***	***	***
N (1)	***	***	NS
N (2)	***	***	NS
N (3)	***	***	NS
N (4)	NS	*	NS
P (1)	***	***	NS
P (2)	***	***	NS
P (3)	***	***	NS
P (4)	***	***	NS
N/P ratio (1)	***	***	NS
N/P ratio (2)	***	***	NS
N/P ratio (3)	***	***	NS
N/P ratio (4)	***	***	NS

* Significant at the 0.05 level.
*** Significant at the 0.001 level.
† NS = not significant.

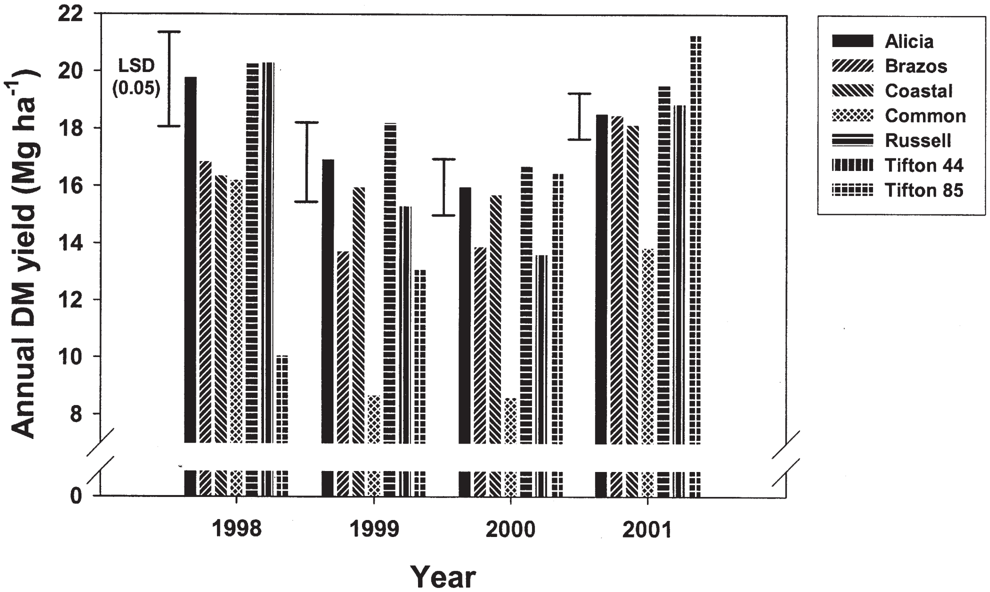

Fig. 2. Annual dry matter (DM) yield of seven bermudagrass cultivars fertilized with broiler litter at Mize, MS. Means represent a significant ($P < 0.001$) year × cultivar interaction (Table 3).

while Tifton 85 stolons may grow more than 7.5 cm d^{-1} and develop roots and a plant at each node when soil moisture and growing conditions are favorable, these plants remain at the surface of the soil and rarely develop crowns in the first year. Increased root development and tillering at these nodes in subsequent years may explain the increasing yield of Tifton 85 that we measured each year, and indicates that this hybrid may require several years to attain maximum yield potential.

Herbage Nitrogen and Phosphorus Concentration

Herbage N concentration was similar among a majority of the hybrid cultivars at each harvest except the third, ranging from 18.4 to 20.3 g kg^{-1} at the first harvest, 17.0 to 17.9 g kg^{-1} at the second harvest, 19.8 to 22.8 g kg^{-1} at the third harvest, and 22.2 to 23.9 g kg^{-1} at the fourth harvest (Fig. 3). In contrast, the N concentration of common bermudagrass herbage was greater than that of all the hybrids except Tifton 85 at the fourth harvest. Similar results were found when these grasses were fertilized with swine effluent (Brink et al., 2003). Nitrogen analysis of the morphological components of common and hybrid bermudagrass fertilized with swine effluent accounts for these differences (Pederson and Brink, 1999). Across three harvests, the stem N concentration of common, Coastal, and Tifton 85 was similar (mean of 19.0 g kg^{-1}), but leaf N concentration of common bermudagrass was greater than that of Coastal and Tifton 85 (26 g kg^{-1} vs. 22.0 and 22.5 g kg^{-1}, respectively)

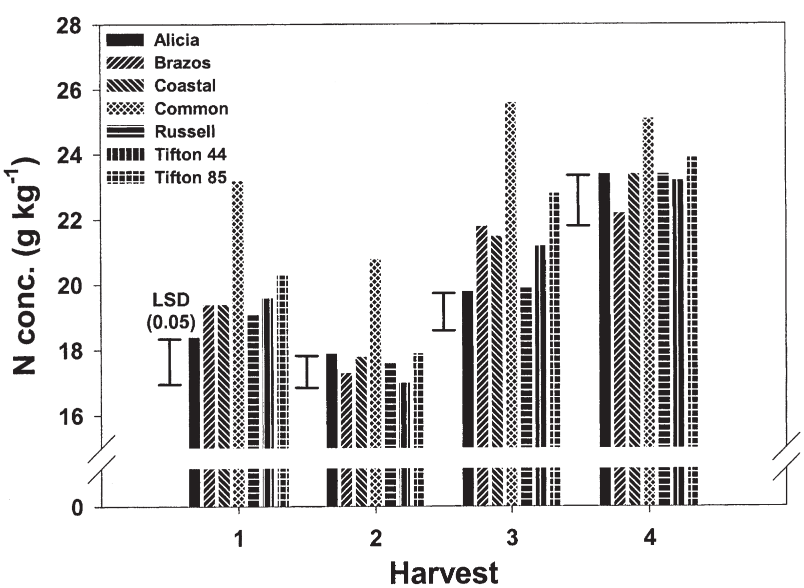

Fig. 3. Nitrogen concentration of seven bermudagrass cultivars fertilized with broiler litter for each of four harvests at Mize, MS (mean of 4 yr). Means represent a significant ($P < 0.001$ for Harvest 1, 2, and 3; and $P < 0.05$ for Harvest 4) cultivar effect for each of the four harvests (Table 3).

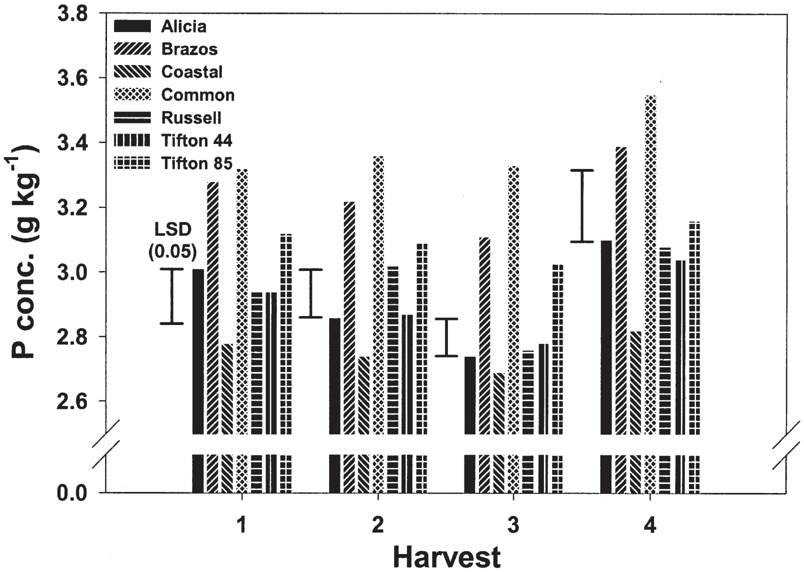

Fig. 4. Phosphorus concentration of seven bermudagrass cultivars fertilized with broiler litter for each of four harvests at Mize, MS (mean of 4 yr). Means represent a significant ($P < 0.001$) cultivar effect for each of the four harvests (Table 3).

and constituted a greater proportion of the total plant biomass (22%) than the stem fraction (15%).

Phosphorus concentration of common bermudagrass ranged from 3.3 to 3.6 g kg^{-1} and was greater than that of the hybrids with the exception of Brazos at the first, second, and fourth harvest (Fig. 4). Similar to N concentration results, this difference is explained by the P concentration of the leaf and stem fractions of common and hybrid bermudagrass. Pederson and Brink (1999) found that common bermudagrass fertilized with swine effluent had greater stem P (2.2 g kg^{-1}) and leaf P (2.1 g kg^{-1}) concentration than that of Coastal or Tifton 85 stems (1.7 and 1.9 g kg^{-1}, respectively) and leaves (1.9 and 1.8 g kg^{-1}, respectively).

Among the hybrids, Brazos had greater P concentration at each harvest than all others except Tifton 85 (Fig. 4). There were few differences in P concentration among Alicia, Coastal, Russell, and Tifton 44, four hybrids with comparable morphology and growth habit. Under the conditions of this experiment (high soil P levels, Table 1; high P application rates, Table 2), P concentration of Coastal ranged from 2.7 to 2.8 g kg^{-1} across all harvests. By comparison, P concentration of Coastal bermudagrass fertilized with 9.2 to 73.6 kg P ha^{-1} as inorganic fertilizer ranged from 1.5 to 2.3 kg^{-1} (Day and Parker, 1985).

Herbage Nitrogen/Phosphorus Ratio

Herbage N/P ratios of bermudagrass cultivars fertilized with litter in this study (Table 4) were less than the ratio of 9.17:1 reported for bermudagrass fertilized with inorganic fertilizer (critical values of 22 g N kg^{-1} and 2.4 g P kg^{-1}; Kelling and Matocha, 1990), primarily due to increased herbage P concentration (Fig. 4). Burns et al. (1990) also measured increased P concentration (3.4–4.2 g kg^{-1}) and reduced N/P ratios (range of 6.8–7.4) of Coastal bermudagrass fertilized with swine effluent for 11 yr to supply 230 to 858 kg P ha^{-1} yr^{-1}. Ranking among cultivars for N/P ratio varied between harvests, but N/P ratio of the large-type cultivars Brazos and Tifton 85 was less than that of Coastal at every harvest (Table 4), again due primarily to greater P concentration of Brazos and Tifton relative to that of Coastal at each harvest (Fig. 4).

Nitrogen and Phosphorus Uptake

Robinson (1996) summarized several studies of warm-season grass response to applied fertilizer and concluded that total nutrient removal by forages is primarily a function of yield. In this study, annual uptake of N and P by bermudagrass was also positively associated with annual DM yield ($r = 0.93$ in 1998, 0.96 in 1999, 0.93 in 2000, and 0.87 in 2001 for N, and $r = 0.93$ in 1998, 0.96 in 1999, 0.90 in 2000, and 0.83 in 2001 for P). Differences in annual DM yield among cultivars, however, were not always indicative of differences in annual N and P uptake, primarily due to greater uptake rates by common bermudagrass, which were attributed to greater N and P concentration of this bermudagrass at most harvests (Fig. 3 and 4). Despite a DM yield difference of 4.0 Mg ha^{-1} between Russell and common in 1998 (Fig. 2), N and P uptake of the two grasses were

Table 4. The N/P ratio of seven bermudagrass cultivars fertilized with broiler litter at each of four harvests at Mize, MS (mean of 4 yr). Means represent a significant ($P < 0.001$) cultivar effect for each of the four harvests (Table 3).

	Harvest			
Cultivar	**1**	**2**	**3**	**4**
Alicia	**6.1**	**6.3**	**7.2**	**7.6**
Brazos	**5.9**	**5.4**	**7.1**	**6.7**
Coastal	**7.0**	**6.6**	**8.0**	**8.4**
Common	**7.0**	**6.2**	**7.9**	**7.3**
Russell	**6.6**	**5.9**	**7.3**	**7.7**
Tifton 44	**6.7**	**6.0**	**7.7**	**7.8**
Tifton 85	**6.4**	**5.9**	**7.6**	**7.8**
LSD(0.05)	**0.5**	**0.5**	**0.4**	**0.6**
CV, %	**11**	**11**	**8**	**8**

Table 5. Annual N and P uptake of seven bermudagrass cultivars fertilized with broiler litter at Mize, MS. Means represent a significant ($P < 0.001$) year × cultivar interaction (Table 3).

	N				P			
Cultivar	1998	1999	2000	2001	1998	1999	2000	2001
	kg ha^{-1}							
Alicia	396	318	246	363	55	50	42	56
Brazos	376	263	214	376	54	44	42	62
Coastal	367	304	248	378	44	45	38	54
Common	396	192	168	331	52	29	27	51
Russell	396	355	263	388	56	54	44	62
Tifton 44	427	288	218	381	58	43	37	59
Tifton 85	244	267	251	440	31	39	43	73
LSD(0.05)	73	62	36	52	11	8	5	8
CV, %	13	15	11	9	15	13	9	9

similar (Table 5). Similarly, DM yield of common was 5.0 Mg ha^{-1} less than that of Tifton 44 in 2001, but again there was no difference in N and P uptake between the two. In contrast, when common bermudagrass yield was lowest in 1999 and 2000 (Fig. 2), N and P uptake by common were less than that of the hybrids.

Relative differences in annual N uptake among the hybrid cultivars were less evident when precipitation was near normal (Fig. 1); Alicia, Brazos, Coastal, Russell, and Tifton 44 had similar N uptake in 1998 and 2001, compared with 1999 and 2000 when Russell had greater N uptake than Brazos and Tifton 44 (Table 5). In contrast, annual P uptake of Russell was greater than that of Coastal in all 4 yr. Like N uptake, P uptake of Alicia and Russell were similar every year of the study. Similar to annual DM yield (Fig. 2), annual N and P uptake of Tifton 85 increased each year, and exceeded that of all cultivars in the final year of the study.

From a nutrient management perspective, harvested herbage should contain the greatest possible quantity of nutrients relative to that applied in the manure to reduce nutrient accumulation in the soil. Because some of the N in the litter is not available in the year it is applied due to mineralization (Gordillo and Cabrera, 1997) and volatilization (Brinson et al., 1994), N uptake efficiencies of 72 to 88% by the six highest yielding cultivars during the two years of adequate precipitation (1998 and 2001; Fig. 1) probably represents maximum N utilization. In contrast, P uptake efficiency of the same cultivars ranged from 14 to 24% due to the large difference between herbage N/P ratio at each harvest (Table 4) and that of the broiler litter (range of 1.55–1.70 for all applications), and because litter was applied at rates intended to meet bermudagrass N requirements. Given that soil P levels at the beginning of the experiment were excessive (577–800 mg kg^{-1}; Table 1), and P application rates ranged from 309 to 364 kg ha^{-1} yr^{-1} (Table 2) compared with P uptake rates ranging from 27 kg P ha^{-1} yr^{-1} (common bermudagrass in 2000) to 73 kg P ha^{-1} yr^{-1} (Tifton 85 in 2001; Table 5), little impact of bermudagrass hay harvest on soil P test could be expected. This was confirmed by Sistani et al. (2004), who found that Mehlich-3 P of soil under Coastal, common, and Tifton 85 was approximately 900 and 750 mg kg^{-1} at 0- to 5- and 5- to 10-cm soil depth, respectively, at the conclusion of the experiment.

CONCLUSIONS

Broiler production is a major agricultural enterprise in many states of the southeastern USA, and nutrient accumulation in soils of bermudagrass pastures and hayfields where litter is routinely applied can be reduced by maximizing forage nutrient uptake. Our results suggest that under optimum growing conditions no differences in N uptake exist among the hybrid bermudagrass cultivars having similar growth morphology (Alicia, Coastal, Russell, and Tifton 44). Relative to Coastal, the first commercialized hybrid bermudagrass and the standard among hybrids, only Russell consistently exhibited superior P uptake. In contrast to the other hybrids, Tifton 85 exhibited increasing DM production in successive years, and in the final year of the study removed more N and P than any hybrid. Common bermudagrass exhibited reduced productivity in years with below-normal precipitation compared with the hybrids, and should not be considered an acceptable alternative to a hybrid. However, the superior N and P concentration of common bermudagrass herbage relative to that of hybrids indicates a potential exists to improve nutrient uptake of seeded bermudagrass varieties by increasing yield.

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